

California Motor Vehicle Fuel Programs: An Overview

**Integrated Energy Policy Report
June 9, 2003**

California Environmental Protection Agency

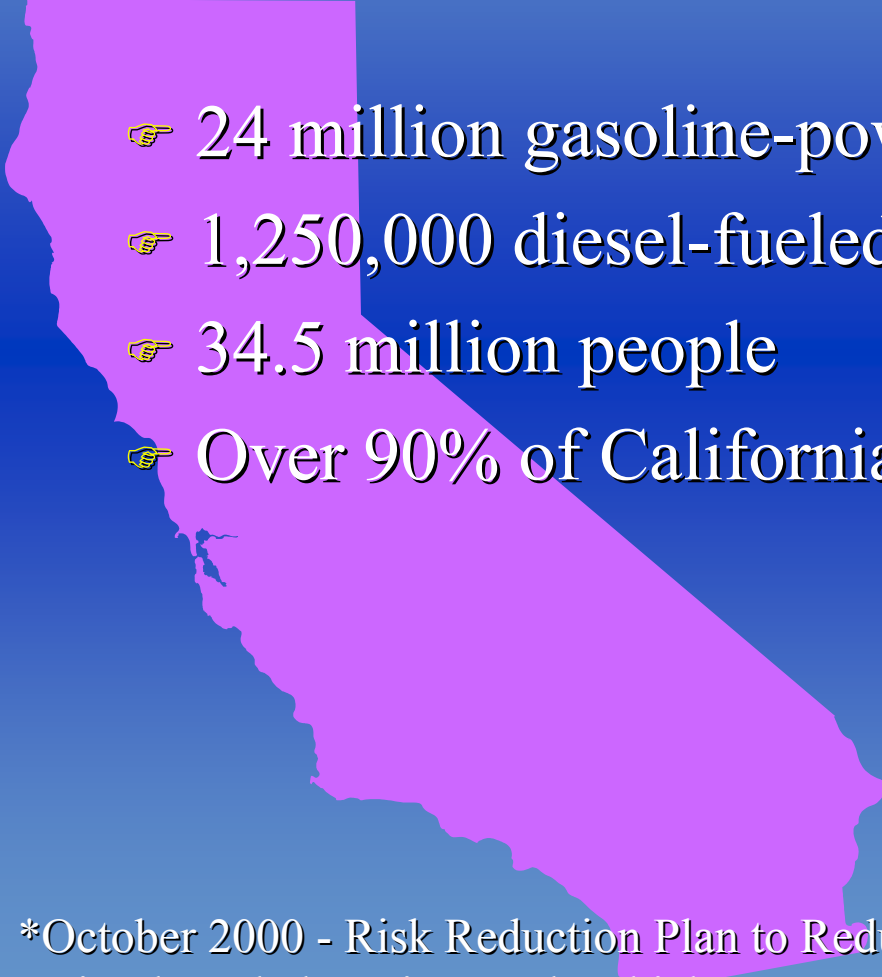


Air Resources Board

Presentation Overview

- ➡ Background
- ➡ Diesel fuel
- ➡ Gasoline
- ➡ Alternative Fuels
- ➡ Summary

California's Air Quality Problem

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- ➡ 24 million gasoline-powered vehicles
 - ➡ 1,250,000 diesel-fueled vehicles and engines*
 - ➡ 34.5 million people
 - ➡ Over 90% of Californians breath unhealthy air

*October 2000 - Risk Reduction Plan to Reduce PM Emissions from Diesel-Fueled Engines and Vehicles

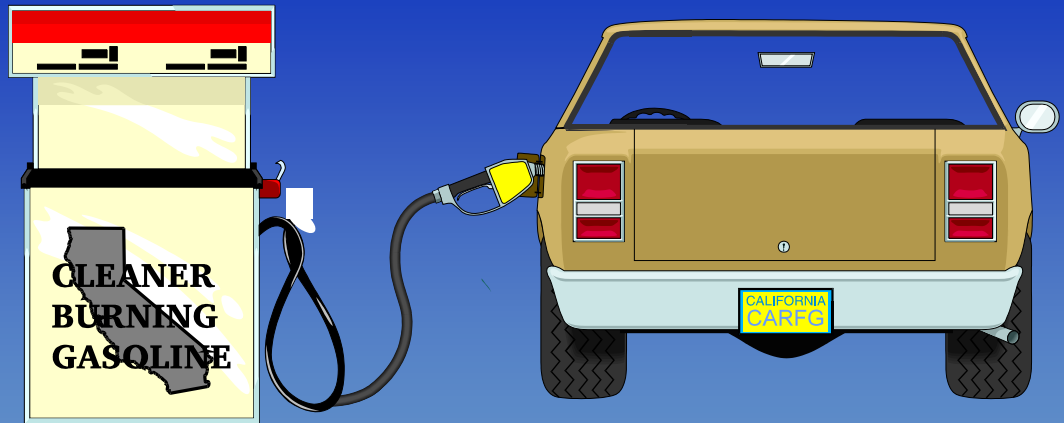
California Clean Air Act

Requirements for Mobile Sources

- ➡ Achieve maximum feasible reductions in PM, CO, and toxic air contaminants
- ➡ Achieve maximum emission reductions of VOC and NOx by earliest practicable date
- ➡ Adopt most effective combination of control measures on all classes of motor vehicles and their fuels

Motor Vehicle Fuels Control Strategy

- ☞ Treat vehicles / fuels as a system
 - Vehicle emission standards
 - Fuel standards
- ☞ Flexible



California's Vehicle Fuels Programs

Year Adopted	Gasoline	Diesel	Alternative Fuels
1971	Reid Vapor Pressure	-----	-----
	Bromine Number	-----	-----
1975	Sulfur	-----	-----
	Manganese/Phosphorus	-----	-----
1976	Lead	-----	-----
1981	-----	Sulfur (SCAB)	-----
1982	Lead	-----	-----
1988	-----	Sulfur/Arom. HC	-----
1990	Phase 1 RFG	-----	-----
	-----	-----	Clean Fuels/LEV
1991	Phase 2 RFG	-----	-----
	Wintertime Oxygenates	-----	-----
1992	-----	-----	Commercial and Certification Specs
1994	Phase 2 RFG Predictive Model	-----	-----
	-----	-----	LPG (amended)
1998	Combustion Chamber Deposits (amended)	-----	-----
	Wintertime Oxygenates (amended)	-----	-----
	-----	-----	LPG (amended)
1999	Wintertime Oxygenates (amended)	-----	-----
	-----	-----	Clean Fuels (amended)
2000	Phase 3 RFG(eliminates MTBE)		
2003	-----	Sulfur (proposed)	

Summary of Fuels Program Benefits

Program	Emissions Reductions (tpd)					
	HC	NOx	PM	SO ₂	CO	Toxics
Diesel (1993)	--	70	20	80	--	25%
CaRFG1 (1992)	210	--	--	--	--	--
CaRFG2 (1996)	190	110	--	30	1300	40%
CaRFG3 (2003)	0.5	19	--	4	--	7%
Total (tpd)	400	190	20	114	1300	na
% Change	15	10	25	80	6	na

Overview of Diesel Regulations

California Diesel Fuel Program

- ➡ Adopted in 1988
- ➡ Implemented October 1993
- ➡ Provides flexibility by allowing certification of equivalent formulations



Comparison of Current Federal and California Diesel Specifications

Property	California	Federal
Sulfur	500 ppmw	500 ppmw
Aromatic Hydrocarbons		
Large Refiners	10 Vol. %	---
Small Refiners	20 Vol. %	---

👉 Applicability

- California: on- and off-road vehicles
- Federal: on-road vehicles only

California Diesel Program Benefits^a

(tons/day)

Pollutant	Federal	California
SO ₂	60	80 (80%)
PM (Directly Emitted)	4	20 ^b (25%)
NO _x	0	70 (7%)

^a Calculated for 1995 Inventory

^b Includes hazardous pollutant benefits from reduced PM.

Average Specifications of Reformulated Diesel Fuel

Specification	California		U.S. ⁽¹⁾
	Pre-1993	1999	1999
Aromatics, vol%	35	19	35
Sulfur, ppmw	440 ⁽²⁾	140 ⁽³⁾	360
Cetane No.	43	50	45
PNA	---	3	---
Nitrogen	---	150	110

1. AAMA National Fuel Surveys
2. For Los Angeles area (Greater than 3000 ppmw in rest of California)
3. About 10 % of total California volume is < 15 ppmw

Other Diesel Fuel Activities

Board Action

- ➡ August 1998, the Board listed particulate matter emissions from diesel-fueled engines as a toxic air contaminant
- ➡ October 2000, the Board approved the diesel risk reduction plan

Diesel Risk Reduction Plan

- ☞ Diesel PM represents about 70% of statewide cancer risk from Toxic Air Contaminants.
- ☞ Comprehensive strategy to reduce diesel PM emissions from new and existing vehicles and engines.
- ☞ Advised by International Diesel Retrofit Advisory Committee
- ☞ Retrofits of existing vehicles and engines are a major component of plan.
- ☞ Includes low sulfur (15 ppm Max) diesel fuel for on and off-road vehicles and engines.
- ☞ Goal is an 85% reduction in PM emissions by 2020.

Other Diesel Fuel Programs

- ➡ South Coast Air Basin adopted 15 ppmw S
 - Stationary source, 2004
 - Mobile source, 2005
- ➡ U.S. EPA, 15 ppmw S requirements
 - Adopted for on-road vehicles, 2006
 - Proposed for non-road engines

Proposed Amendments for California Diesel Fuel

- ✎ Lower CARB diesel sulfur limit to 15 ppmw
- ✎ Implement in 2006
- ✎ Apply to:
 - On-road and off-road engines
 - Stationary sources (Air Toxic Control Measure)
- ✎ Necessary to implement diesel PM risk reduction plan
- ✎ Update diesel certification fuel specifications

Gasoline Programs

California Phase 2 Gasoline (CaRFG2) Program

- ☞ Adopted in 1991
- ☞ Implemented March 1996



☞ Limits on the following fuel parameters:

T50
T90
Sulfur
Olefins
Benzene
Oxygen Content
RVP (Summertime)
Aromatic Hydrocarbons

Typical Properties¹ of CaRFG2

T50, deg F	201
T90, deg F	310
Sulfur, ppmw	22
Olefins, vol%	4.5
Benzene, vol%	0.6
Oxygen, wt%	2.0
RVP, psi	6.8
Aromatic HC, vol%	23

¹ Based on 1999 CEC ARB survey of California refiner's summertime fuel

CaRFG2 Benefits

- ☞ Emission reductions equivalent to removing 3.5 million vehicles from region's roads
- ☞ Reduces smog forming emissions from motor vehicles by 15%
- ☞ Reduces benzene emissions by half
- ☞ Reduces potential cancer risk from vehicle emissions by 40%
- ☞ 1/4 of SIP reductions in 1996

California Phase 3 Reformulated Gasoline (CaRFG3) Regulations

- ➡ Approved on December 9, 1999
- ➡ Implement the Governor's Executive Order
- ➡ Remove MTBE From California gasoline by December 31, 2003
- ➡ Provide additional flexibility to remove MTBE and use ethanol
- ➡ Enhance emission benefits of current program
- ➡ Accommodate need for imports on routine basis



Approved CaRFG3 Specifications Compared to CaRFG2

Property	Flat Limits		Cap Limits	
	Current	Approved	Current	Approved
RVP, psi	7.0	7.0 ⁽¹⁾	7.0	6.4-7.2
Benzene, vol%	1.00	0.80	1.20	1.10
Sulfur, ppmw	40	20	80	60/30 ⁽²⁾
Aromatic HC, vol%	25	same	30	35
Olefins, vol. %	6.0	same	10	same
Oxygen, wt. %	1.8 to 2.2	same	0-3.5	0-3.7 ⁽³⁾
T50 °F	210	213	220	220
T90 °F	300	305	330	330

1) Equal to 6.9 psi. if using the evaporative element of the Predictive Model

2) 60 ppmw. will apply December 31, 2003; 30 ppmw. will apply December 31, 2005

3) Allow 3.7 for gasoline containing no more than 10 volume percent ethanol

CaRFG3 Implementation Issues

- ➡ Refineries converted to ethanol-blended gasoline, about 70% of state's gasoline supply
- ➡ Rest of refineries to convert by Nov 2003
- ➡ Only 3 more major terminals to modify
- ➡ Full compliance, Jan 2004

Alternative Fuels

Alternative Fuel Programs

- ➡ As demand for conventional fuels increase and emissions standards continue to become more stringent the opportunities for alternative fuels and advanced technology vehicles will continue to increase.
- ➡ Ensure that low-emission vehicles designed to operate on alternative fuels will have commercially available fuels which result in expected emissions performance
- ➡ Recognize and encourage certification of low-emission alternative-fuel vehicles

Alternative Fuels Specifications Have Been Adopted by the ARB

- ☞ Fuel methanol (M-100, M-85)
- ☞ Fuel ethanol (E-100, E-85)
- ☞ Compressed natural gas (CNG)
- ☞ Liquefied petroleum gas (LPG)
- ☞ Hydrogen



CNG Issues

- ➡ CNG quality issues in Southern San Joaquin Valley & South Central Coast
 - Off specification CNG can damage engine and increase emissions
 - Off specification CNG limits the expansion of CNG fleets and fueling stations
- ➡ Working to provide more flexibility in specifications

Summary

- ➡ Cleaner-burning fuels are a critical part of improving air quality
- ➡ The ARB treats vehicles and fuels as a system
- ➡ Fuels regulations provide immediate emissions reductions
- ➡ Vehicle emissions regulations provide increasing reductions over a longer period of time
- ➡ While conventional Clean Fuels will continue to dominate the marketplace Alternative Clean Fuels have a role to play - Demand for both will continue to grow with time.